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(54)【発明の名称】　プラスチック加工用スクリュ

(57)【要約】
【課題】　可塑化性能を低下させることなく、可塑化された樹脂温度の均一化を図ることができるプラスチック加工用スクリュを提供する。
【解決手段】　加熱されたシリンダ11内に回転自在に設けられ、回転することにより、該シリンダ11内に投入された熱可塑性樹脂を混練しつつ移送してシリンダ11からの熱で可塑化させるプラスチック加工用スクリュ13であって、有効長Lと外径Dとの比L／Dが5乃至8.88である。なお、ネジピッチPと外径Dとの比P／Dを0.5乃至0.66とするとさらに好ましい。

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【特許請求の範囲】

【請求項１】　加熱されたシリンダ内に回転自在に設けられ、回転することにより、該シリンダ内に投入された熱可塑性樹脂を混練しつつ移送して前記シリンダからの熱で可塑化させるプラスチック加工用スクリュにおいて、

有効長Ｌと外径Ｄとの比Ｌ／Ｄが５乃至８．８８であることを特徴とするプラスチック加工用スクリュ。

【請求項２】　ネジピッチＰと外径Ｄとの比Ｐ／Ｄが０．５乃至０．６６であることを特徴とする請求項１記載のプラスチック加工用スクリュ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、加熱されたシリンダ内に回転自在に設けられ、回転することにより、シリンダ内に投入された熱可塑性樹脂を混練しつつ移送してシリンダからの熱で可塑化させるプラスチック加工用スクリュに関する。

【０００２】

【従来の技術】射出成形機等のプラスチック加工機械には、熱可塑性樹脂を可塑化させるためにプラスチック加工用スクリュを用いたものがある。このプラスチック加工用スクリュは、加熱されたシリンダ内に回転自在に設けられ、回転することにより、シリンダ内に投入された熱可塑性樹脂を混練しつつ移送してシリンダからの熱で可塑化させるようになっている。このようなプラスチック加工用スクリュとして、従来は、有効長Ｌと外径Ｄとの比Ｌ／Ｄが２０近辺のもので、ネジピッチＰと外径Ｄとの比Ｐ／Ｄが０．８乃至１．０の範囲（ほとんどのものは１．０）のものが使用されている。また、プラスチック加工用スクリュの先端部とシリンダとの間に繰り出された熱可塑性樹脂の増加に伴ってプラスチック加工用スクリュが後退するストローク（スクリュの先端の最も前進した位置からの移動距離）は外径Ｄの４倍程度に設定されている。例えば、金型の型締力が１８０トンの射出成形機の最も一般的なスクリュは、外径Ｄが４５ｍｍ、有効長Ｌが１０００ｍｍ近辺、ネジピッチＰが外径Ｄと同じ４５ｍｍのものであり、ストロークは外径Ｄの４倍の１８０ｍｍである。

【０００３】

【発明が解決しようとする課題】ところで、可塑化工程中は、可塑化された熱可塑性樹脂がプラスチック加工用スクリュの先端部とシリンダとの間に繰り出され、この繰出量の増加に伴ってプラスチック加工用スクリュが後退することになる。そして、このときのストロークが大きいと、シリンダへの熱可塑性樹脂の投入口に対しても、プラスチック加工用スクリュが後退し、よって投入口からプラスチック加工用スクリュの先端部までの距離が短くなるため、可塑化後半部の樹脂の温度が大きく低下してしまうという問題があった。具体的には、図３に

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示すように、全ストロークの１８０ｍｍに対し８０ｍｍを越えると、樹脂温度の低下が顕著になってしまう。したがって、本発明の目的は、可塑化性能を低下させることなく、可塑化された樹脂温度の均一化を図ることができるプラスチック加工用スクリュを提供することである。

【０００４】

【課題を解決するための手段】本発明の請求項１記載のプラスチック加工用スクリュは、加熱されたシリンダ内に回転自在に設けられ、回転することにより、該シリンダ内に投入された熱可塑性樹脂を混練しつつ移送して前記シリンダからの熱で可塑化させるものであって、有効長Ｌと外径Ｄとの比Ｌ／Ｄが５乃至８．８８であることを特徴としている。また、本発明の請求項２記載のプラスチック加工用スクリュは、上記に加えて、ネジピッチＰと外径Ｄとの比Ｐ／Ｄが０．５乃至０．６６であることを特徴としている。

【０００５】

【発明の実施の形態】本発明の射出成形機の一の実施の形態を図面を参照して以下に説明する。図１において、符号１１は所定温度に加熱維持される略円筒状のシリンダ、符号１２はシリンダ１１の側部に設けられ該シリンダ１１内に樹脂を投入するためのホッパー、符号１３はシリンダ１１内に挿入されたプラスチック加工用スクリュ（以下スクリュと称す）、符号１４はスクリュ１３を回転させるスクリュ回転装置、符号１５はスクリュ１３を前進・後退させる射出用油圧シリンダ、符号１６はスクリュの先端に設けられた逆流防止弁、符号１７はシリンダ１１の先端に形成された樹脂出口であるノズル部、をそれぞれ示している。ここで、図１（ａ）はスクリュ１３が前進端に位置する状態、図（ｂ）はスクリュ１３が後退端に位置する状態をそれぞれ示しており、スクリュ１３の有効長Ｌは、図１（ａ）に示すように、該スクリュ１３がシリンダ１１内で最も前進した状態において、シリンダ１１内に熱可塑性樹脂を投入するためのホッパー１２からネジが形成された部分の先端までの距離のことであり、ストロークＳはスクリュ１３の最も前進した位置から最も後退した位置までの移動距離のことである。また、図２に示すように、ネジピッチＰはスクリュ１３の軸線方向における隣り合うネジ山間の距離のこと、スクリュ外径Ｄはスクリュ１３のネジ山部分における外径のことである。

【０００６】次に、金型の型締力が１８０トンの射出成形機の最も一般的な、外径Ｄが４５ｍｍ、有効長Ｌが１０００ｍｍ近辺、ネジピッチＰが外径Ｄと同じ４５ｍｍ、ストロークが外径Ｄの４倍の１８０ｍｍの従来のスクリュの場合、図３に示すように、回転数が１００／ｍｉｎ、１５０／ｍｉｎ、２００／ｍｉｎのいずれの場合においても、全ストロークＳの１８０ｍｍに対し１／２．２５の８０ｍｍを越えると、樹脂温度の低下が顕著

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になってしまう。このため、この全ストロークに対する樹脂温度低下が無視できる範囲の比1／2．25を用い前記従来のスクリュのストロークの比1／2．25以下にストロークSを縮小することが温度低下を防止する上で有効となることがわかる。

【0007】ここで、従来のスクリュとほぼ同等な可塑化能力、射出容量を可能にし、温度低下を防止できる新たなスクリュを考える場合、前記従来のスクリュを有効長L1、外径D_1、ネジピッチP_1、ストロークS_1とし、新たなスクリュを有効長L_2、外径D_2、ネジピッチP_2、ストロークS_2とし、有効長の比$L_1／L_2＝m$とす*

$$L_2／D_2＝（（1／m）×L_1）／（m×D_1）＝（1／m^2）×（L_1／D_1）$$
　　　　　…（式4）

となる。

【0008】一方、スクリュストロークを比$S_2／S_1$に※

$$射出容量＝S_1 D_1{}^2 π／4＝S_2 D_2{}^2 π／4　　　…（式5）$$

となり、$S_2／S_1$比は、

$$S_2／S_1＝D_1{}^2／D_2{}^2＝D_1{}^2／（mD_1）^2＝1／m^2　　　…（式6）$$

となり、ストローク比$S_2／S_1＝1／m^2$なる関係が成立する。そして、スクリュストロークを1／2．25に縮小する場合は、（式6）より、

$$S_2／S_1＝1／m^2＝1／2．25　　　…（式7）$$

となり、従来のスクリュの$L_1／D_1$をほぼ20とすると、このスクリュの$L_2／D_2$比は、（式4）より、$L_2／D_2＝1／2．25×20＝8．88$となる。よって、L／D＝8．88以下にすることで樹脂の温度低下を防止することができる。ここで、L／Dが5より小さくなると長さに対し外径が大きすぎることになり、実用的でなくなる。したがって、L／Dは5乃至8．88となる。

【0009】また、$1／m^2＝1／2．25$すなわち$m＝1．5$であり、略ピッチは、$P_1＝P_2＝P$であるとすると、

$$P／D_2＝P／（mD_1）＝0．66$$

となる。よって、P／Dを0．66以下にすることが有効であることもわかる。ここで、P／Dが0．5より小さくなるとネジピッチに対し外径が大きすぎることになり、実用的でなくなる。したがって、P／Dは0．5乃至0．66となる。また、L／Dが5乃至8．88の範囲にあるとき、スクリュが加熱シリンダから受ける熱量が同じとすると、mは1．5乃至2となり、結果として、スクリュの有効長が前記従来のスクリュに対し短縮できる。

【0010】

【実施例】次に、上記を検証するため実験を行った。なお、図2に示すように、スクリュの有効長Lに相当する部分は、先端側から、一定谷径の計量部L_M、計量部L_M側が該計量部L_Mと同径で該計量部L_Mから離間するにしたがい小径となる谷径をなすテーパ状の圧縮部L_C、該圧縮部L_Cの計量部L_Mに対し反対側と同径の一定谷径の

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*ると、

$$L_2＝（1／m）×L_1　　　…（式1）$$

ストロークを短くしても加熱シリンダから受ける熱量を同じにするためには、スクリュの溝を平面に展開した場合の溝の面積が等しければよく、このことは、スクリュの外径側の表面積が同一であることに略相当するため、

$$π×D_2×L_2＝π×D_1×L_1　　　…（式2）$$

であり、よって、

$$D_2＝m×D_1　　　…（式3）$$

結果として、

※縮少するということは、従来スクリュと同一の射出容量を確保するため、

供給部L_Fとから構成されており、これらの長さの比$L_M：L_C：L_F$がゾーン比と呼ばれ、また計量部L_Mにおけるネジ山と谷との距離が計量部溝深さh_Mと呼ばれ、供給部におけるネジ山と谷との距離が供給部溝深さh_Fと呼ばれる。

【0011】そして、実験を行ったスクリュの諸元は、有効長L＝300mm、スクリュ外径45mm、ネジピッチP＝24、L／D＝6．66、P／D＝0．533、供給部溝深さ4．4mm、計量部溝深さ1．9mm、ゾーン比$L_M：L_C：L_F$＝5．5：2．5：2、圧縮比2．3のものである。また、樹脂はポリプロピレンPP（宇部　J−109G）を用い、シリンダの温度は230℃とした。

【0012】その結果、実施例のスクリュについて、シリンダ内の樹脂の温度分布は、図4に示すように、28／min、56／min、111／min、167／min、194／minの各スクリュ回転数において、スクリュストロークの全般にわたって樹脂温度が極端に低下することなくほぼ一定するという結果が得られた。

【0013】ここで、実施例のスクリュが温度低下が発生しない代りに可塑化能力が極端に低下することがあるか否かを従来スクリュと比較確認するため、比較例として、有効長L＝540mm、スクリュ外径25mm、ネジピッチP＝25、L／D＝21．6、P／D＝1．0で、それ以外は実施例と同様の諸元の一般的なスクリュと、比較実験を行った。図5は比較例のスクリュのスクリュ回転数と可塑化能力（単位時間当りの可塑化樹脂量）との関係を、図6は実施例のスクリュのスクリュ回転数と可塑化能力との関係を、図7は比較例のスクリュの回転数と所要トルクとの関係を、図8は実施例のスクリュの回転数と所要トルクとの関係を、それぞれ複数の背圧条件について示している。

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【００１４】そして、例えば背圧３ＭＰａの条件下において、比較例のスクリュは図５からスクリュの回転数が２７３／ｍｉｎのときの可塑化能力が１７．８ｋｇ／ｈであり、このときの駆動トルクが図７から１．５ｋｇ・ｍであるのに対し、実施例のスクリュでは、図６に示すように同じ可塑化能力１７．８ｋｇ／ｈが得られるのは、スクリュ回転数が１８７／ｍｉｎのときであり、このときの所要トルクは図８から５ｋｇ・ｍであることが読み取れる。ここで、実施例のスクリュの外径は４５ｍｍで比較例のスクリュの２５ｍｍに対し１．８倍の値となっており、よって、比較例のスクリュの回転数である２７３／ｍｉｎとスクリュ外周周速度を同じくした等価な実施例のスクリュの回転数は２７３／１．８＝１５２／ｍｉｎであり、この回転数のときの可塑化能力は図６から１４ｋｇ／ｈで、比較例のスクリュの１７．８ｋｇ／ｈより若干低いがほぼ近い値と判定でき、よって、実施例のスクリュでも十分な可塑化能力が得られると判定できる。

【００１５】

【発明の効果】以上詳述したように、本発明のプラスチック加工用スクリュによれば、有効長Ｌと外径Ｄとの比Ｌ／Ｄを５乃至８．８８としたので、樹脂の温度低下を防止することができる。なお、ネジピッチＰと外径Ｄとの比Ｐ／Ｄを０．５乃至０．６６とするとさらに好ましい。

【図面の簡単な説明】

【図１】プラスチック加工用スクリュおよびシリンダ等を示す断面図であって、（ａ）はスクリュが前進端に位置する状態、図（ｂ）はスクリュが後退端に位置する状態をそれぞれ示している。

【図２】プラスチック加工用スクリュを示す側面図であ*

*る。

【図３】外径Ｄが４５ｍｍ、Ｌ／Ｄが２０、ストロークが１８０ｍｍ、背圧１０ＭＰａのスクリュのストローク位置（横軸）に対するシリンダ内の樹脂温度（縦軸）の関係を示す特性線図である。

【図４】スクリュの実施例のストローク位置（横軸）に対するシリンダ内の樹脂温度（縦軸）の関係を示す特性線図である。

【図５】スクリュの比較例のスクリュ回転数（横軸）に対する可塑化能力（縦軸）の関係を示す特性線図である。
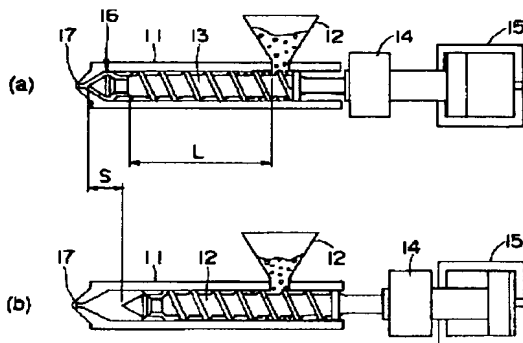
【図６】スクリュの実施例のスクリュ回転数（横軸）に対する可塑化能力（縦軸）の関係を示す特性線図である。

【図７】スクリュの比較例のスクリュ回転数（横軸）に対する駆動トルク（縦軸）の関係を示す特性線図である。

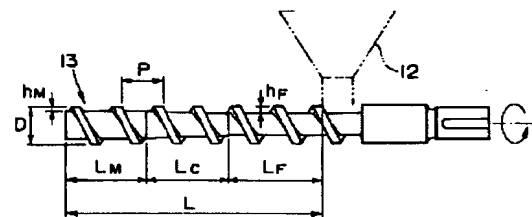【図８】スクリュの実施例のスクリュ回転数（横軸）に対する駆動トルク（縦軸）の関係を示す特性線図である。

【符号の説明】

１１　シリンダ
１２　ホッパー
１３　プラスチック加工用スクリュ
１４　スクリュ回転装置
１５　射出用油圧シリンダ
１６　逆流防止弁
１７　ノズル部
Ｄ　外径
Ｌ　有効長
Ｐ　ネジピッチ

【図１】

【図２】

【図3】

背圧　10MPa　　　樹脂：PP

st=180mm　　　スクリュ外径φ45　　　L／D＝20

【図4】

背圧　10MPa　　　樹脂：PP

st=26mm　　　スクリュ外径φ45　　　L／D＝6.66

【図5】

樹脂：PP　　　スクリュ外径φ25　　　L／D＝21.6

【図6】

樹脂：PP　　スクリュ外径φ45　　L／D=6.66

樹脂背圧
●　：3MPa
○　：5MPa
■　：10MPa
□　：15MPa

可塑化能力　（Kg/h）

スクリュ回転数　　（min⁻¹）

【図7】

樹脂：PP　　スクリュ外径φ25　　L／D=21.6

樹脂背圧
●　：3MPa
□　：15MPa

正味駆動（最大）トルク　（Kgm）

スクリュ回転数　　（min⁻¹）

【図8】

樹脂：PP　　スクリュ外径φ45　　L／D=6.66

樹脂背圧
●　：3MPa
□　：15MPa

正味駆動（最大）トルク　（Kgm）

スクリュ回転数　　（min⁻¹）

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(71)Applicant :   NIIGATA ENG CO LTD

(72)Inventor :   MIYOSHI YOJI

OYA HIROSHI

ORITA HIROHARU

(54) PLASTIC PROCESSING SCREW

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a plastic processing screw capable of uniformly adjusting the temp. of a plasticized resin without lowering plasticizing capacity.

SOLUTION: A plastic processing screw 13 is provided in a heated cylinder 11 in a freely rotatable manner and rotated to knead and transfer the thermoplastic resin charged in the cylinder 11 to plasticize the same by the heat from the cylinder 11. In this screw, the ratio L/D of the effective length L and outer diameter D thereof 5-88.8. The ratio P/D of the screw pitch P and outer diameter D thereof is more pref. set to 0.5-0.66.

LEGAL STATUS

[Date of request for examination]   20.03.1998

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PATENT ABSTRACTS OF JAPAN

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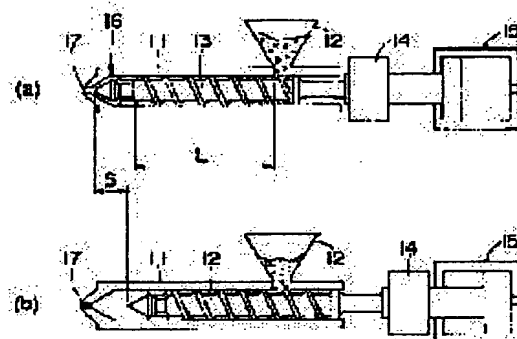(43)Date of publication of application : 22.04.1997

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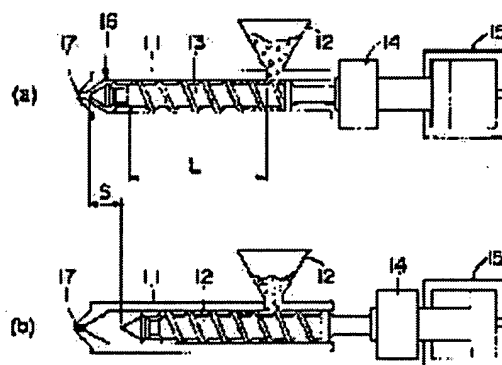| (21)Application number : 07-264114 | (71)Applicant : NIIGATA ENG CO LTD |
(22)Date of filing : 12.10.1995	(72)Inventor : MIYOSHI YOJI
	OYA HIROSHI
	ORITA HIROHARU

(54) PLASTIC PROCESSING SCREW

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a plastic processing screw capable of uniformly adjusting the temp. of a plasticized resin without lowering plasticizing capacity.

SOLUTION: A plastic processing screw 13 is provided in a heated cylinder 11 in a freely rotatable manner and rotated to knead and transfer the thermoplastic resin charged in the cylinder 11 to plasticize the same by the heat from the cylinder 11. In this screw, the ratio L/D of the effective length L and outer diameter D thereof 5-88.8. The ratio P/D of the screw pitch P and outer diameter D thereof is more pref. set to 0.5-0.66.

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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] the screw for plastic working which transports, kneading the thermoplastics which was prepared free [rotation] in the heated cylinder and was thrown in in this cylinder by rotating, and is made to plasticize with the heat from said cylinder -- setting -- the ratio of effective length L and an outer diameter D -- the screw for plastic working characterized by ratios of length to diameter being 5 thru/or 8.88.
[Claim 2] the ratio of the screw pitch P and an outer diameter D -- the screw for plastic working according to claim 1 characterized by P/D being 0.5 thru/or 0.66.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is prepared free [rotation] in the heated cylinder, and relates to the screw for plastic working which transports, kneading the thermoplastics thrown in in the cylinder and is made to plasticize with the heat from a cylinder by rotating.
[0002]
[Description of the Prior Art] In order to make plastic working machines, such as an injection molding machine, plasticize thermoplastics, there are some which used the screw for plastic working in them. This screw for plastic working is prepared free [rotation] in the heated cylinder, is transported kneading the thermoplastics thrown in in the cylinder, and is made to plasticize with the heat from a cylinder by rotating. as such a screw for plastic working -- the former -- the ratio of effective length L and an outer diameter D -- ratio of length to diameter -- the thing of the 20 neighborhoods -- it is -- the ratio of the screw pitch P and an outer diameter D -- the thing of the range of 0.8 thru/or 1.0 (almost all things are 1.0) is used for P/D. Moreover, the stroke (migration length from the location where the tip of a screw moved forward most) to which the screw for plastic working retreats with the increment in the thermoplastics which it let out between the point of the screw for plastic working and the cylinder is set as about 4 times of an outer diameter D. For example, for an outer diameter D, 45mm and effective length L are [nearly 1000mm and the screw pitch P of the most general screw of the injection molding machine whose mold locking force of metal mold is 180t] the 45mm same things as an outer diameter D, and a stroke is 180 4 times as muchmm as an outer diameter D.
[0003]
[Problem(s) to be Solved by the Invention] By the way, as for the inside of a plasticization process, the plasticized thermoplastics will let out between the point of the screw for plastic working, and a cylinder, and the screw for plastic working will retreat with the increment in this amount of deliveries. And if the stroke at this time was large, since the screw for plastic working would retreat and the distance from input port to the point of the screw for plastic working would therefore become short also to the input port of the thermoplastics to a cylinder, there was a problem that the temperature of the resin of the section will fall greatly in the second half of plasticization. If 80mm is specifically exceeded to 180mm of all strokes as shown in drawing 3 , the fall of resin temperature will become remarkable. Therefore, the purpose of this invention is offering the screw for plastic working which can attain equalization of the plasticized resin temperature, without reducing the plasticization engine performance.
[0004]
[Means for Solving the Problem] the thing which transports, kneading the thermoplastics which the screw for plastic working of this invention according to claim 1 was prepared free [rotation] in the heated cylinder, and was thrown in in this cylinder by rotating, and is made to plasticize with the heat from said cylinder -- it is -- the ratio of effective length L and an outer diameter D -- it is characterized by ratios of length to diameter being 5 thru/or 8.88. moreover, the screw for plastic working of this invention according to claim 2 -- the above -- in addition, the ratio of the screw pitch P and an outer

diameter D -- it is characterized by P/D being 0.5 thru/or 0.66.

[0005]

[Embodiment of the Invention] The gestalt of operation of one of the injection molding machine of this invention is explained below with reference to a drawing. The approximately cylindrical cylinder by which heating maintenance of the sign 11 is carried out in drawing 1 at predetermined temperature, The hopper for a sign 12 being formed in the flank of a cylinder 11, and throwing in resin in this cylinder 11, The screw for plastic working by which the sign 13 was inserted into the cylinder 11 (a screw is called below), The screw slewing gear which a sign 14 makes rotate a screw 13, the oil hydraulic cylinder for injection to which a sign 15 moves forward and retreats a screw 13, The check valve by which the sign 16 was formed at the tip of a screw, and the sign 17 show the nozzle section which is the resin outlet formed at the tip of a cylinder 11, respectively. As for drawing 1 (a), the condition that a screw 13 is located in an advance edge, and the condition that, as for drawing (b), a screw 13 is located in a retreat edge are shown here, respectively. The effective length L of a screw 13 In the condition that this screw 13 moved forward most within the cylinder 11 as shown in drawing 1 (a) It is the thing of the distance to the tip of a part where the screw was formed from the hopper 12 for throwing in thermoplastics in the cylinder 11, and Stroke S is the migration length from the location where the screw 13 moved forward most to the location which retreated most. Moreover, as shown in drawing 2 , the thing of the distance between adjacent screw threads [in / in the screw pitch P / the direction of an axis of a screw 13] and the screw outer diameter D are outer diameters in the screw thread part of a screw 13.

[0006] The most general outer diameter D of the injection molding machine whose mold locking force of metal mold is 180t Next, 45mm, Nearly 1000mm and the screw pitch P The 45 samemm as an outer diameter D, [effective length L] When a stroke is the 4 times as many conventional screw it is [screw] 180mm as an outer diameter D, <A To HREF="/Tokujitu/tjitemdrw.ipdl?N0000=239&N0500=1 E_N/;?6>?;?:9///&N0001=206&N0552=9&N 0553= 000005" TARGET="tjitemdrw"> drawing 3 If 1/2.25 of 80mm is exceeded to 180mm of all strokes S when a rotational frequency is any of 100/min, and 150 / min200/min so that it may be shown, the fall of resin temperature will become remarkable. For this reason, it turns out that it becomes effective when reducing Stroke S to 1/2.25 or less ratio of a stroke of said conventional screw using the ratios 1/2.25 of the range which can disregard the resin temperature fall to these the strokes of all prevents a temperature fall.

[0007] Plasticizing capacity almost equivalent to the conventional screw and shot capacity are made possible here. When considering the new screw which can prevent a temperature fall, said conventional screw is considered as effective length $L1$, an outer diameter $D1$, the screw pitch $P1$, and stroke $S1$. When [consider a new screw as effective length $L2$, an outer diameter $D2$, the screw pitch $P2$, and stroke $S2$, and] effective length's ratio $L1/L2=m$, it is $L2=(1/m) xL1$. -- (formula 1)

Even if it shortens a stroke, in order to make the same the heating value received from a heating cylinder, the area of the slot at the time of developing the slot on the screw at a flat surface should be just equal, and this is $pixD 2xL2= pixD 1xL1$, in order to carry out an abbreviation equivalent to the surface area by the side of the outer diameter of a screw being the same. -- (formula 2)

Come out, and it is and, therefore, is $D2=mxD1$. -- (formula 3)

As a result $L2/D2=(1/m) (xL1)/(mxD1) =(1/m2) x (L1/D1)$

-- (formula 4)

It becomes.

[0008] In order that reducing a screw stroke to ratios $S2/S1$ may, on the other hand, secure the same shot capacity as a screw conventionally Shot capacity $= S1D12pi / 4=S2D 22pi/4$ -- (formula 5)

Next door and $S2-/S1$ ratio $S2-/S1=D12 / D22=D12 / (mD1) 2= 1/m2$ -- (formula 6)

A next door and the relation it is unrelated stroke ratio $S2/S 1= 1-/m2$ are materialized. And when reducing a screw stroke to 1/2.25, it is $S2/S1=1/m2=1/2.25$ from (a formula 6). -- (formula 7)

If $L1/D1$ of a next door and the conventional screw is set to about 20, $L2 / D2$ ratio of this screw will be set to $L2/D2=1/2.25x20=8.88$ from (a formula 4). Therefore, the temperature fall of resin can be prevented by making it less than [ratio-of-length-to-diameter=8.88]. When ratio of length to diameter becomes smaller than 5, an outer diameter will be too large to die length, and it becomes here, less

practical. Therefore, ratio of length to diameter is set to 5 thru/or 8.88.

[0009] Moreover, it is 1/m2=1 / 2.25, m= 1.5 [i.e.,], and supposing an abbreviation pitch is P1=P2=P, it will be set to P/D2=P/(mD1) =0.66. Therefore, it also turns out that it is effective to make P/D or less into 0.66. When P/D becomes smaller than 0.5, an outer diameter will be too large to a screw pitch, and it becomes here, less practical. Therefore, P/D is set to 0.5 thru/or 0.66. Moreover, when ratio of length to diameter is in the range of 5 thru/or 8.88, if [a screw] the heating value received from a heating cylinder is the same, m is set to 1.5 thru/or 2 and the effective length of a screw can shorten it to said conventional screw as a result.

[0010]

[Example] Next, it experimented in order to verify the above. As shown in drawing 2 , in addition, the part equivalent to the effective length L of a screw The taper-like compression zone LC which makes the root diameter which turns into a minor diameter from a tip side as a metering zone [of a fixed root diameter] LM and metering zone LM side estranges from this metering zone LM with this metering zone LM and the diameter of said It consists of feed zones LF of the fixed root diameter of the opposite side and the diameter of said to the metering zone LM of this compression zone LC. the ratio of such die length -- LM:LC:LF is called a zone ratio, and the distance of the screw thread and trough in a metering zone LM is called the metering zone channel depth hM, and the distance of the screw thread and trough in a feed zone is called the feed zone channel depth hF.

[0011] and the item of a screw which experimented -- the effective length of L= 300mm, the screw outer diameter of 45mm, the screw pitch P= 24, ratio-of-length-to-diameter=6.66, P/D=0.533, the feed zone channel depth of 4.4mm, the metering zone channel depth of 1.9mm, and a zone ratio -- it is the thing of LM:LC:LF=5.5:2.5:2 and a compression ratio 2.3. Moreover, resin made temperature of a cylinder 230 degrees C using Polypropylene PP (Ube J-109G).

[0012] consequently, about the screw of an example, as the temperature distribution of the resin in a cylinder were shown in drawing 4 , the result of taking about 1 law was obtained, without resin temperature falling extremely over a screw stroke at large in each screw speed of 28/min, and 56 / min111/min167 / min194/min.

[0013] Here, in order to carry out the comparison check of whether plasticizing capacity may fall to instead of [which a temperature fall does not generate / the screw of an example] extremely with a screw conventionally, the general screw of the same item as an example and comparative experiments were conducted as an example of a comparison except it by the effective length of L= 540mm, the screw outer diameter of 25mm, the screw pitch P= 25, ratio-of-length-to-diameter=21.6, and P/D=1.0. drawing 5 -- the relation between the screw speed of the screw of the example of a comparison, and plasticizing capacity (the amount of plasticization resin per unit time amount) -- drawing 6 -- drawing 7 shows the relation between the rotational frequency of the screw of the example of a comparison, and necessary torque, and drawing 8 shows the relation between the rotational frequency of the screw of an example, and necessary torque for the relation between the screw speed of the screw of an example, and plasticizing capacity about two or more back pressure conditions, respectively.

[0014] And as the screw of the example of a comparison shows by the screw of an example at drawing 6 to plasticizing capacity in case the rotational frequencies of a screw are 273/min from drawing 5 being 17.8 kg/h, and the driving torque at this time being 1.5 kg-m from drawing 7 under the condition of back pressure 3MPa, it is a time of screw speeds being 187/min that the same plasticizing capacity 17.8 kg/h is obtained, for example, and the necessary torque at this time can read that they are 5 kg-m in drawing 8 . The outer diameter of the screw of an example is 1.8 times the value of this to 25mm of the screw of the example of a comparison here by 45mm. Therefore, the rotational frequency of the screw of the equivalent example which made the same 273-/min which is the rotational frequency of the screw of the example of a comparison, and screw periphery peripheral velocity is 273/1.8= 152-/min. The plasticizing capacity at the time of this rotational frequency is 14 kg/h from drawing 6 , although it is lower than 17.8 kg/h of the screw of the example of a comparison a little, it can judge with an almost near value, and it can judge with therefore plasticizing capacity sufficient also by the screw of an example being acquired.

[0015]
[Effect of the Invention] according to [as explained in full detail above] the screw for plastic working of this invention -- the ratio of effective length L and an outer diameter D -- since ratio of length to diameter was set to 5 thru/or 8.88, the temperature fall of resin can be prevented. in addition, the ratio of the screw pitch P and an outer diameter D -- it is still more desirable when P/D is set to 0.5 thru/or 0.66.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Field of the Invention] This invention is prepared free [rotation] in the heated cylinder, and relates to
the screw for plastic working which transports, kneading the thermoplastics thrown in in the cylinder
and is made to plasticize with the heat from a cylinder by rotating.

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] In order to make plastic working machines, such as an injection molding machine, plasticize thermoplastics, there are some which used the screw for plastic working in them. This screw for plastic working is prepared free [rotation] in the heated cylinder, is transported kneading the thermoplastics thrown in in the cylinder, and is made to plasticize with the heat from a cylinder by rotating. as such a screw for plastic working -- the former -- the ratio of effective length L and an outer diameter D -- ratio of length to diameter -- the thing of the 20 neighborhoods -- it is -- the ratio of the screw pitch P and an outer diameter D -- the thing of the range of 0.8 thru/or 1.0 (almost all things are 1.0) is used for P/D. Moreover, the stroke (migration length from the location where the tip of a screw moved forward most) to which the screw for plastic working retreats with the increment in the thermoplastics which it let out between the point of the screw for plastic working and the cylinder is set as about 4 times of an outer diameter D. For example, for an outer diameter D, 45mm and effective length L are [nearly 1000mm and the screw pitch P of the most general screw of the injection molding machine whose mold locking force of metal mold is 180t] the 45mm same things as an outer diameter D, and a stroke is 180 4 times as muchmm as an outer diameter D.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] according to [as explained in full detail above] the screw for plastic working of this invention -- the ratio of effective length L and an outer diameter D -- since ratio of length to diameter was set to 5 thru/or 8.88, the temperature fall of resin can be prevented. in addition, the ratio of the screw pitch P and an outer diameter D -- it is still more desirable when P/D is set to 0.5 thru/or 0.66.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, as for the inside of a plasticization process, the plasticized thermoplastics will let out between the point of the screw for plastic working, and a cylinder, and the screw for plastic working will retreat with the increment in this amount of deliveries. And if the stroke at this time was large, since the screw for plastic working would retreat and the distance from input port to the point of the screw for plastic working would therefore become short also to the input port of the thermoplastics to a cylinder, there was a problem that the temperature of the resin of the section will fall greatly in the second half of plasticization. If 80mm is specifically exceeded to 180mm of all strokes as shown in drawing 3 , the fall of resin temperature will become remarkable. Therefore, the purpose of this invention is offering the screw for plastic working which can attain equalization of the plasticized resin temperature, without reducing the plasticization engine performance.

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MEANS

[Means for Solving the Problem] the thing which transports, kneading the thermoplastics which the screw for plastic working of this invention according to claim 1 was prepared free [rotation] in the heated cylinder, and was thrown in in this cylinder by rotating, and is made to plasticize with the heat from said cylinder -- it is -- the ratio of effective length L and an outer diameter D -- it is characterized by ratios of length to diameter being 5 thru/or 8.88. moreover, the screw for plastic working of this invention according to claim 2 -- the above -- in addition, the ratio of the screw pitch P and an outer diameter D -- it is characterized by P/D being 0.5 thru/or 0.66.
[0005]
[Embodiment of the Invention] The gestalt of operation of one of the injection molding machine of this invention is explained below with reference to a drawing. The approximately cylindrical cylinder by which heating maintenance of the sign 11 is carried out in drawing 1 at predetermined temperature, The hopper for a sign 12 being formed in the flank of a cylinder 11, and throwing in resin in this cylinder 11, The screw for plastic working by which the sign 13 was inserted into the cylinder 11 (a screw is called below), The screw slewing gear which a sign 14 makes rotate a screw 13, the oil hydraulic cylinder for injection to which a sign 15 moves forward and retreats a screw 13, The check valve by which the sign 16 was formed at the tip of a screw, and the sign 17 show the nozzle section which is the resin outlet formed at the tip of a cylinder 11, respectively. As for drawing 1 (a), the condition that a screw 13 is located in an advance edge, and the condition that, as for drawing (b), a screw 13 is located in a retreat edge are shown here, respectively. The effective length L of a screw 13 In the condition that this screw 13 moved forward most within the cylinder 11 as shown in drawing 1 (a) It is the thing of the distance to the tip of a part where the screw was formed from the hopper 12 for throwing in thermoplastics in the cylinder 11, and Stroke S is the migration length from the location where the screw 13 moved forward most to the location which retreated most. Moreover, as shown in drawing 2 , the thing of the distance between adjacent screw threads [in / in the screw pitch P / the direction of an axis of a screw 13] and the screw outer diameter D are outer diameters in the screw thread part of a screw 13.
[0006] The most general outer diameter D of the injection molding machine whose mold locking force of metal mold is 180t Next, 45mm, When the 45 samemm as an outer diameter D and a stroke are the 4 times as many conventional screws which are 180mm as an outer diameter D, as nearly 1000mm and the screw pitch P show drawing 3 , effective length L If 1/2.25 of 80mm is exceeded to 180mm of all strokes S when a rotational frequency is any of 100/min, and 150 / min200/min, the fall of resin temperature will become remarkable. For this reason, it turns out that it becomes effective when reducing Stroke S to 1/2.25 or less ratio of a stroke of said conventional screw using the ratios 1/2.25 of the range which can disregard the resin temperature fall to these the strokes of all prevents a temperature fall.
[0007] Plasticizing capacity almost equivalent to the conventional screw and shot capacity are made possible here. When considering the new screw which can prevent a temperature fall, said conventional screw is considered as effective length L1, an outer diameter D1, the screw pitch P1, and stroke S1. When [consider a new screw as effective length L2, an outer diameter D2, the screw pitch P2, and

stroke S2, and] effective length's ratio $L1/L2=m$, it is $L2=(1/m) \times L1$. -- (formula 1)
Even if it shortens a stroke, in order to make the same the heating value received from a heating cylinder, the area of the slot at the time of developing the slot on the screw at a flat surface should be just equal, and this is $pi \times D2 \times L2 = pi \times D1 \times L1$, in order to carry out an abbreviation equivalent to the surface area by the side of the outer diameter of a screw being the same. -- (formula 2)
Come out, and it is and, therefore, is $D2=m \times D1$. -- (formula 3)
As a result $L2/D2=(1/m) \times (L1)/(m \times D1) = (1/m2) \times (L1/D1)$
-- (formula 4)
It becomes.
[0008] In order that reducing a screw stroke to ratios S2/S1 may, on the other hand, secure the same shot capacity as a screw conventionally Shot capacity $= S1 D12 pi / 4 = S2 D 22 pi/4$ -- (formula 5)
Next door and S2-/S1 ratio $S2-/S1=D12 / D22=D12 / (mD1) 2= 1/m2$ -- (formula 6)
A next door and the relation it is unrelated stroke ratio $S2/S 1= 1-/m2$ are materialized. And when reducing a screw stroke to 1/2.25, it is $S2/S1=1/m2=1/2.25$ from (a formula 6). -- (formula 7)
If L1/D1 of a next door and the conventional screw is set to about 20, L2 / D2 ratio of this screw will be set to $L2/D2=1/2.25 \times 20=8.88$ from (a formula 4). Therefore, the temperature fall of resin can be prevented by making it less than [ratio-of-length-to-diameter=8.88]. When ratio of length to diameter becomes smaller than 5, an outer diameter will be too large to die length, and it becomes here, less practical. Therefore, ratio of length to diameter is set to 5 thru/or 8.88.
[0009] Moreover, it is $1/m2=1 / 2.25$, m= 1.5 [i.e.,], and supposing an abbreviation pitch is P1=P2=P, it will be set to $P/D2=P/(mD1) =0.66$. Therefore, it also turns out that it is effective to make P/D or less into 0.66. When P/D becomes smaller than 0.5, an outer diameter will be too large to a screw pitch, and it becomes here, less practical. Therefore, P/D is set to 0.5 thru/or 0.66. Moreover, when ratio of length to diameter is in the range of 5 thru/or 8.88, if [a screw] the heating value received from a heating cylinder is the same, m is set to 1.5 thru/or 2 and the effective length of a screw can shorten it to said conventional screw as a result.

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EXAMPLE

[Example] Next, it experimented in order to verify the above. As shown in drawing 2 , in addition, the part equivalent to the effective length L of a screw The taper-like compression zone LC which makes the root diameter which turns into a minor diameter from a tip side as a metering zone [of a fixed root diameter] LM and metering zone LM side estranges from this metering zone LM with this metering zone LM and the diameter of said It consists of feed zones LF of the fixed root diameter of the opposite side and the diameter of said to the metering zone LM of this compression zone LC. the ratio of such die length -- LM:LC:LF is called a zone ratio, and the distance of the screw thread and trough in a metering zone LM is called the metering zone channel depth hM, and the distance of the screw thread and trough in a feed zone is called the feed zone channel depth hF.
[0011] and the item of a screw which experimented -- the effective length of L= 300mm, the screw outer diameter of 45mm, the screw pitch P= 24, ratio-of-length-to-diameter=6.66, P/D=0.533, the feed zone channel depth of 4.4mm, the metering zone channel depth of 1.9mm, and a zone ratio -- it is the thing of LM:LC:LF=5.5:2.5:2 and a compression ratio 2.3. Moreover, resin made temperature of a cylinder 230 degrees C using Polypropylene PP (Ube J-109G).
[0012] consequently, about the screw of an example, as the temperature distribution of the resin in a cylinder were shown in drawing 4 , the result of taking about 1 law was obtained, without resin temperature falling extremely over a screw stroke at large in each screw speed of 28/min, and 56 / min111/min167 / min194/min.
[0013] Here, in order to carry out the comparison check of whether plasticizing capacity may fall to instead of [which a temperature fall does not generate / the screw of an example] extremely with a screw conventionally, the general screw of the same item as an example and comparative experiments were conducted as an example of a comparison except it by the effective length of L= 540mm, the screw outer diameter of 25mm, the screw pitch P= 25, ratio-of-length-to-diameter=21.6, and P/D=1.0. drawing 5 -- the relation between the screw speed of the screw of the example of a comparison, and plasticizing capacity (the amount of plasticization resin per unit time amount) -- drawing 6 -- drawing 7 shows the relation between the rotational frequency of the screw of the example of a comparison, and necessary torque, and drawing 8 shows the relation between the rotational frequency of the screw of an example, and necessary torque for the relation between the screw speed of the screw of an example, and plasticizing capacity about two or more back pressure conditions, respectively.
[0014] And as the screw of the example of a comparison shows by the screw of an example at drawing 6 to plasticizing capacity in case the rotational frequencies of a screw are 273/min from drawing 5 being 17.8 kg/h, and the driving torque at this time being 1.5 kg-m from drawing 7 under the condition of back pressure 3MPa, it is a time of screw speeds being 187/min that the same plasticizing capacity 17.8 kg/h is obtained, for example, and the necessary torque at this time can read that they are 5 kg-m in drawing 8 . The outer diameter of the screw of an example is 1.8 times the value of this to 25mm of the screw of the example of a comparison here by 45mm. Therefore, the rotational frequency of the screw of the equivalent example which made the same 273-/min which is the rotational frequency of the screw of the example of a comparison, and screw periphery peripheral velocity is 273/1.8= 152-/min. The

plasticizing capacity at the time of this rotational frequency is 14 kg/h from <u>drawing 6</u> , although it is lower than 17.8 kg/h of the screw of the example of a comparison a little, it can judge with an almost near value, and it can judge with therefore plasticizing capacity sufficient also by the screw of an example being acquired.
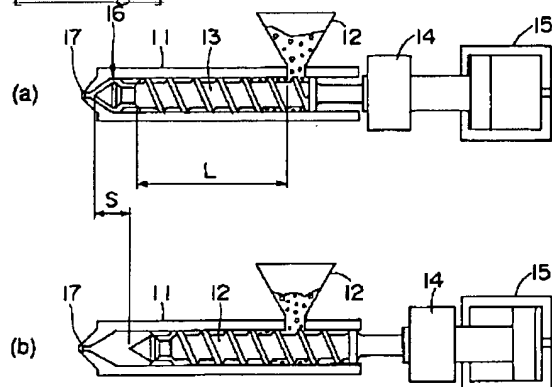

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the screw for plastic working, a cylinder, etc., and, as for (a), the condition that a screw is located in an advance edge, and drawing (b) show the condition that a screw is located in a retreat edge, respectively.
[Drawing 2] It is the side elevation showing the screw for plastic working.
[Drawing 3] An outer diameter D is the characteristic ray Fig. showing the relation of the resin temperature (axis of ordinate) in a cylinder [as opposed to / as opposed to / in 45mm and ratio of length to diameter / 20 / the stroke location (axis of abscissa) of the screw of 180mm and back pressure 10MPa in a stroke].
[Drawing 4] It is the characteristic ray Fig. showing the relation of the resin temperature (axis of ordinate) in the cylinder to the stroke location (axis of abscissa) of the example of a screw.
[Drawing 5] It is the characteristic ray Fig. showing the relation of the plasticizing capacity (axis of ordinate) over the screw speed (axis of abscissa) of the example of a comparison of a screw.
[Drawing 6] It is the characteristic ray Fig. showing the relation of the plasticizing capacity (axis of ordinate) over the screw speed (axis of abscissa) of the example of a screw.
[Drawing 7] It is the characteristic ray Fig. showing the relation of the driving torque (axis of ordinate) over the screw speed (axis of abscissa) of the example of a comparison of a screw.
[Drawing 8] It is the characteristic ray Fig. showing the relation of the driving torque (axis of ordinate) over the screw speed (axis of abscissa) of the example of a screw.
[Description of Notations]
11 Cylinder
12 Hopper
13 Screw for Plastic Working
14 Screw Slewing Gear
15 Oil Hydraulic Cylinder for Injection
16 Check Valve
17 Nozzle Section
D Outer diameter
L Effective length
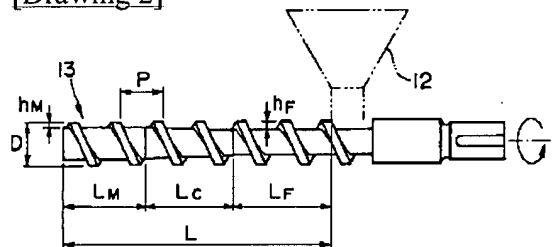P Screw pitch

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[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
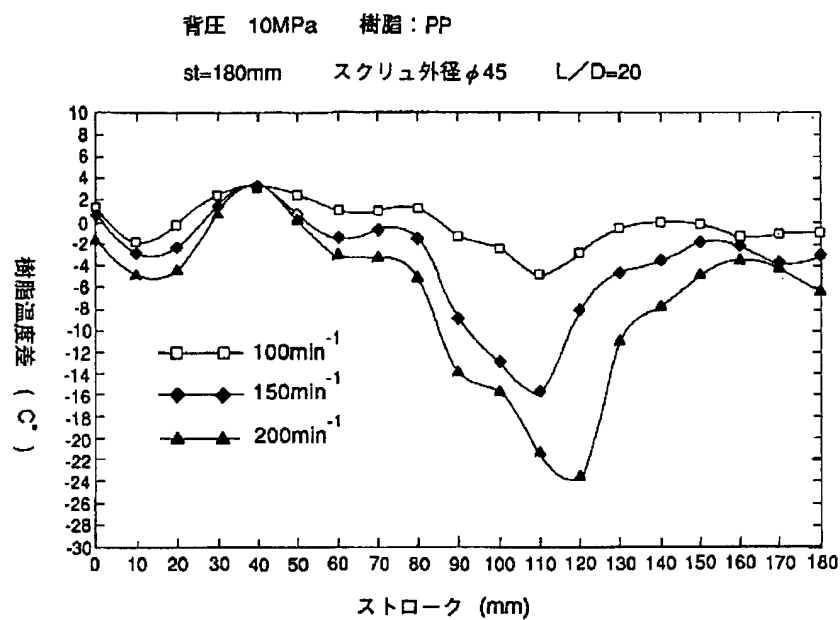3.In the drawings, any words are not translated.
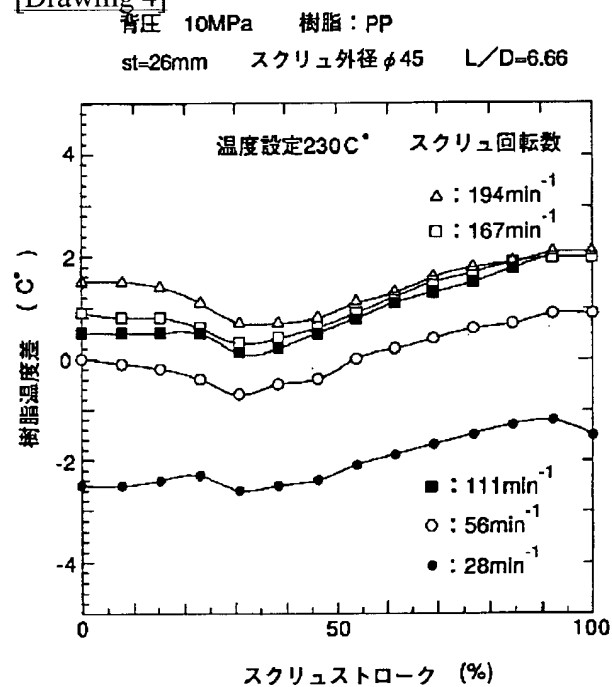

DRAWINGS

[Drawing 1]

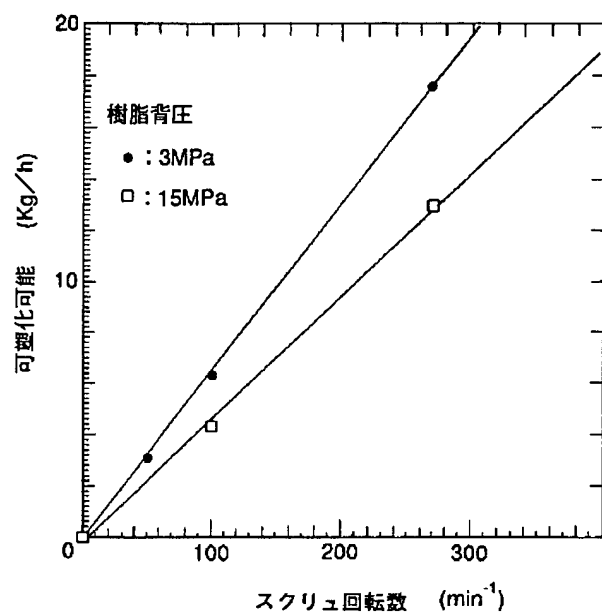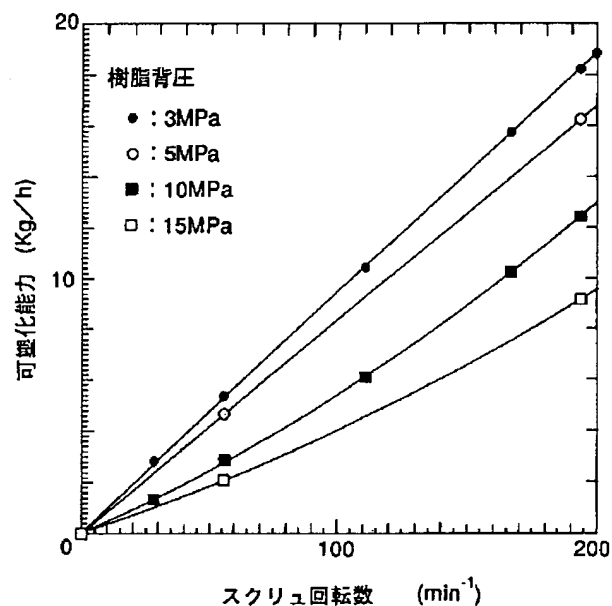
(a)

(b)

[Drawing 2]

[Drawing 3]

背圧　10MPa　　樹脂：PP

st=180mm　　スクリュ外径φ45　　L／D=20

凡例：
□ 100min⁻¹
◆ 150min⁻¹
▲ 200min⁻¹

縦軸：樹脂温度差（C°）
横軸：ストローク（mm）

[Drawing 4]

背圧　10MPa　　樹脂：PP

st=26mm　　スクリュ外径φ45　　L／D=6.66

温度設定230C°　　スクリュ回転数

△：194min⁻¹
□：167min⁻¹

■：111min⁻¹
○：56min⁻¹
●：28min⁻¹

縦軸：樹脂温度差（C°）
横軸：スクリュストローク（%）

[Drawing 5]

樹脂：PP   スクリュ外径φ25   L／D=21.6

[Drawing 6]

樹脂：PP   スクリュ外径φ45   L／D=6.66

[Drawing 7]

樹脂：PP　　スクリュ外径φ25　　L／D=21.6

樹脂背圧
●：3MPa
□：15MPa

正味駆動（最大）トルク　（Kgm）

スクリュ回転数　　（min^{-1}）

[Drawing 8]
樹脂：PP　　スクリュ外径φ45　　L／D=6.66

樹脂背圧
●：3MPa
□：15MPa

正味駆動（最大）トルク　（Kgm）

スクリュ回転数　　（min^{-1}）

[Translation done.]